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# The influence of moral sensitivity on organizational cooperation

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**Abstract**

**Purpose** – The purpose of this paper is to present how to model moral sensitivity and emotions in organizational setting by using the SocLab formal framework. SocLab is a platform for the modelling, simulation and analysis of cooperation relationships within social organizations – and more generally Systems of Organized Action.

**Design/methodology/approach** – Simulation results, including an interesting tendency for a Free Rider model, will be given. Considering that actors' decision-making processes are not just driven by instrumental interest, the SocLab learning simulation algorithm has been extended to represent moral sensitivity, making actors trying to prevent bad emotions and feel good ones.

**Findings** – Some simulation results about actors' collaboration and emotions in a Free Rider model were presented. A noteworthy tendency is that actors' unconditional collaboration, which occurs when their moral sensitivity reaches its highest value, is not so good since it exempts other actors from collaboration (they take advantage from the unconditional collaboration), while values of moral sensitivity somewhat below the highest value (between 0.7 and 0.9) still induces collaboration from others.

**Originality/value** – The research and results presented in this paper have not been presented in other papers or workshops. The presented quantitative definition of emotions (determining indexes of emotions) is different to previous approaches – for instance, to Ortony, Clore and Collins (OCC) qualitative descriptions and to logical descriptions. Similarly, simulation of morality in organizations is a new research field, which has received scarce attention up to now.

**Keywords** Decision making, Organizational structures, Social systems, Modelling, Game theory, Simulation

## 1. Introduction

Social simulation consists in the modelling of social systems, including economics, organization, politics, history or social-ecological systems (see, e.g. the *JASSS* online journal for a number of examples), for the study of their behaviour and emergent properties by the performance of computer simulations (Axelrod, 1997).

Regarding the simulation of social relationships (Squazzoni, 2012), Sibertin-Blanc *et al.* (2013a) proposes a formalization of the Sociology of Organized Action (Crozier and Friedberg, 1980) which studies how social organizations are regularized, as a result of the counterbalancing processes among the power relationships of the social actors. According to this theory, the behaviour of each actor is strategic while being framed by his bounded rationality (Simon, 1998). In this approach, the interaction context defines a social game, where each actor adjusts his behaviour with regard to others in order, as a meta-objective, to obtain a satisfying level of capability to reach its goals. The aim of a social game is to find stationary states, i.e. a configuration where actors no longer modify their behaviour because each one satisfies himself with the level of capability he obtains from the current state of the game, so that the organization is in a regularized configuration and can durably operate in this way.

The formalization implemented in the SocLab platform (El Gemayel, 2013) enables to define the structure of an organization as an instance of a generic meta-model, to study its structural properties with analytical tools, to explore the space of its possible configurations (and so to discover its Pareto optima, Nash equilibriums, structural conflicts and so on), and to compute by simulation, as a result of the social game, how it is plausible that each actor behaves with regard to others within this organizational context.

The SocLab framework has been applied to the study of concrete organizations (see e.g. Sibertin-Blanc *et al.*, 2006; Adreit *et al.*, 2010; El-Gemayel *et al.*, 2011; Sibertin-Blanc *et al.*, 2013a) on the basis of sociological inquiries. However, in some cases, the simulation algorithm that makes actors to play the social game (Sibertin-Blanc and El Gemayel, 2013b) provides results about the behaviour of some actors that do not accurately match the field observations.

This gap between the observed and the computed behaviours can be ascribed to the fact that SocLab neglects emotions. However, it is well known that, along phenomena such reputation and trust (Giardini *et al.*, 2013), social emotions are an essential driver of the regulation of actors' behaviours within organizational settings. Consciously or not, social actors seek to experience positive emotions (such as joy, pride or gratification) and to avoid negative ones (shame, remorse and so on). Thus, they anticipate the possible outcomes of their behaviour on themselves and on others in proportion of their moral sensitivity.

Thus, a moral sensibility parameter has been introduced in the SocLab's decision-making process of actors. This parameter incites an actor to select a behaviour that satisfies not only its own capability to reach its goals but also its contribution to the capability of others and so the proper working of the whole organization.

By the way, the consideration of this individual parameter shed light on the social emotions that actors are likely to feel within organizations. To this end, we follow the Ortony *et al.* (1988) theory of emotions Ortony, Clore and Collins (OCC) to propose a quantitative measure of moral emotions assessed in terms of the actor's situations at SocLab regulated configurations, that is configuration resulting from simulations. A preliminary work was presented in Terán *et al.* (2014a, b). To illustrate this proposal, simulation results of a Free Rider model are offered, in which we have found the following tendency: when some actors have their largest value of moral sensibility ($\text{ms} = 1$), and consequently are strongly collaborative, other actors take advantage of this and exempt from collaborating. Thus, the best level of collaboration within a System of Organised Action (SOA) is reached when actors' ms is somewhere below the maximal value (in (0.7, 0.9)).

The paper is organized as follows. The second section introduces the SocLab modelling framework. The third section gives a short overview of the OCC theory. Section 4 explains how the moral sensibility parameter is introduced in the learning algorithm, and defines some quantitative measures of emotions. Section 5 presents simulation results for a Free Rider model. And, finally, Section 6 depicts some conclusions.

## 2. SocLab

To enable the modelling of social relationships between the actors of an organization, SocLab proposes a meta-model that catches the common concepts and properties of social organizations and is instantiated on specific cases as models of concrete or virtual organizations or, more generally, SOA (Crozier and Friedberg, 1980). Accordingly, the model of the structure of an organization is composed of instances of the *Actor* and *Relation* types that are linked by *Control* and *Depend* associations.

Figure 1 shows the meta-model of organizations' structures as a UML class diagram. A relation is founded on an organization's resource, or a set of related resources, that is controlled by a single actor. Resources are material or cognitive (factual or procedural believes or expectations) elements required to achieve some intended actions, so that their availability is necessary for some actors to reach their goals.

The *state* attribute of a relation represents the behaviour of the controller actor with regard to the availability of the resource for the ones who needs it. Its range of value SB goes from the least cooperative behaviour, −1, of the controller preventing the access to the resource, to the most cooperative behaviours, 1, favouring this access, while the 0 value stands for neutral behaviours.

The *stake* attribute of the dependence of an actor on a relation corresponds to the actor's need of the relation to reach its own goal, on a scale:

$$null = 0,\ negligible = 1, \ldots, significant = 5, \ldots, critical = 10.$$

The effect function evaluates how much the state of the relation makes the resource available to the actor, so that $effect_r$: $A \times SB_r \rightarrow [-10, 10]$ has values in:

$$worst\ access = -10, \ldots, neutral = 0, \ldots, optimal\ access = 10.$$

In addition, actors may have solidarities the ones with regard to others, defined by as function:

$$solidarity(a, b) \rightarrow [-1, 1],$$

where negative values correspond to hostilities and positive values to effective friendships.

Defining the state, or configuration, of an organization as the vector of all relations states, each state of the organization determines on the one hand how much each actor has the means he needs to achieve his goals, defined as:

$$satisfaction(a, s) = \sum_{c \in A} \sum_{r \in R} solidarity(a, c) * stake(c, r) * effect_r(c, s_r). \quad (1)$$

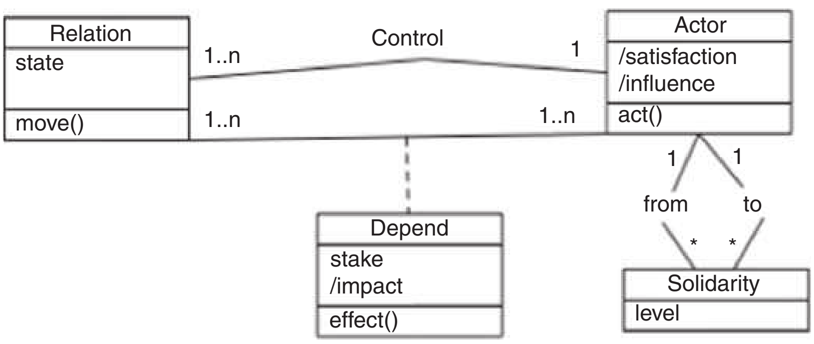



**Figure 1.**
The core of the meta-model of the structure of systems of organized action

and, on the other hand, how much it contributes to the satisfactions of each other actor, defined as:

$$influence(a, b, s) = \sum\nolimits_{r \in R;\, a \text{ controls } r} \sum\nolimits_{c \in A} solidarity(b, c) * stake(c, r) * effect_r(c, s_r). \tag{2}$$

This interaction context defines a *social game*, where each actor seeks, as a meta-objective, to obtain from others enough satisfaction to reach its goals and, to this end, adjusts the state of the relations he controls. Doing so, it modifies the value of its influence and therefore the satisfaction of actors who depend on the relations it controls.

The end of a social game is to reach a stationary state: there, actors do no longer change the state of the relations they control, because everyone accepts his level of satisfaction provided by the current state of the game, so that the organization is in a *regulated configuration* and can steadily work in this way.

The actors' strategic behaviour is framed by their bounded rationality (Simon, 1998), where the actors' decision-making process is implemented as a process of trial and error based on a self-learning rule system. Each actor manages a variable that corresponds to his ambition, and the game ends when the satisfaction of every actor exceeds his ambition (see Sibertin-Blanc *et al.*, 2014b) for details about this collaborative learning process.

To sum up, each simulation run yields a regularized configuration which associates to each actor numerical values for its satisfaction and its influence, and these values may be used to determine whether this configuration is able to arouse a kind of emotion.

## 3. The OCC theory of emotions

Emotions are a very active field of research in many scientific domains (biology, cognitive or social psychology, etc.), leading to a fragmented view of this notion. We characterize emotion by using the theory of Ortony *et al.*'s (1988) OCC which relies on the appraisal view of emotions (Moors *et al.*, 2013). This model of emotions is well funded and widely recognized as a standard in computer science, notably in Multi-Agents-Based Simulation, and it deals with all social emotions we have to consider.

Following OCC, emotions are linked to events, to actions of people (oneself or other) or to objects. Emotions are either positive or negative (their valence) and classified in a tree structure (see Figure 2), as follows: first, in case the linked element is an event that affects the achievement of a goal, the outcome of the event is appraised either as desirable or as undesirable, and the actor feels either pleased or displeased, correspondingly; second, in case the linked element is an action that complies or not with a behavioural norm, the actor appraises the action either as praiseworthy or blameworthy, and his reaction will be either approval or disapproval; third, in case the linked element is an object, the actor appraises the object either as appealing or unappealing and so he will either likes or dislikes it. In SocLab only the two first kinds of emotions appear: goal based (e.g. related with properties of a configuration whose occurrence is an event) and norm based (e.g. regarding the behaviour of one actor towards another one or towards the whole SOA) since actors do not face objects. Emotions related to prospected events can also not be considered, because the SocLab model of actors accounts just their current situation, not their expectations. A SocLab event corresponds to the fact that a simulation experiment puts the organization in a certain configuration. Then, the feeling of an actor corresponds to its positive or negative appraisal of its contribution to this configuration.

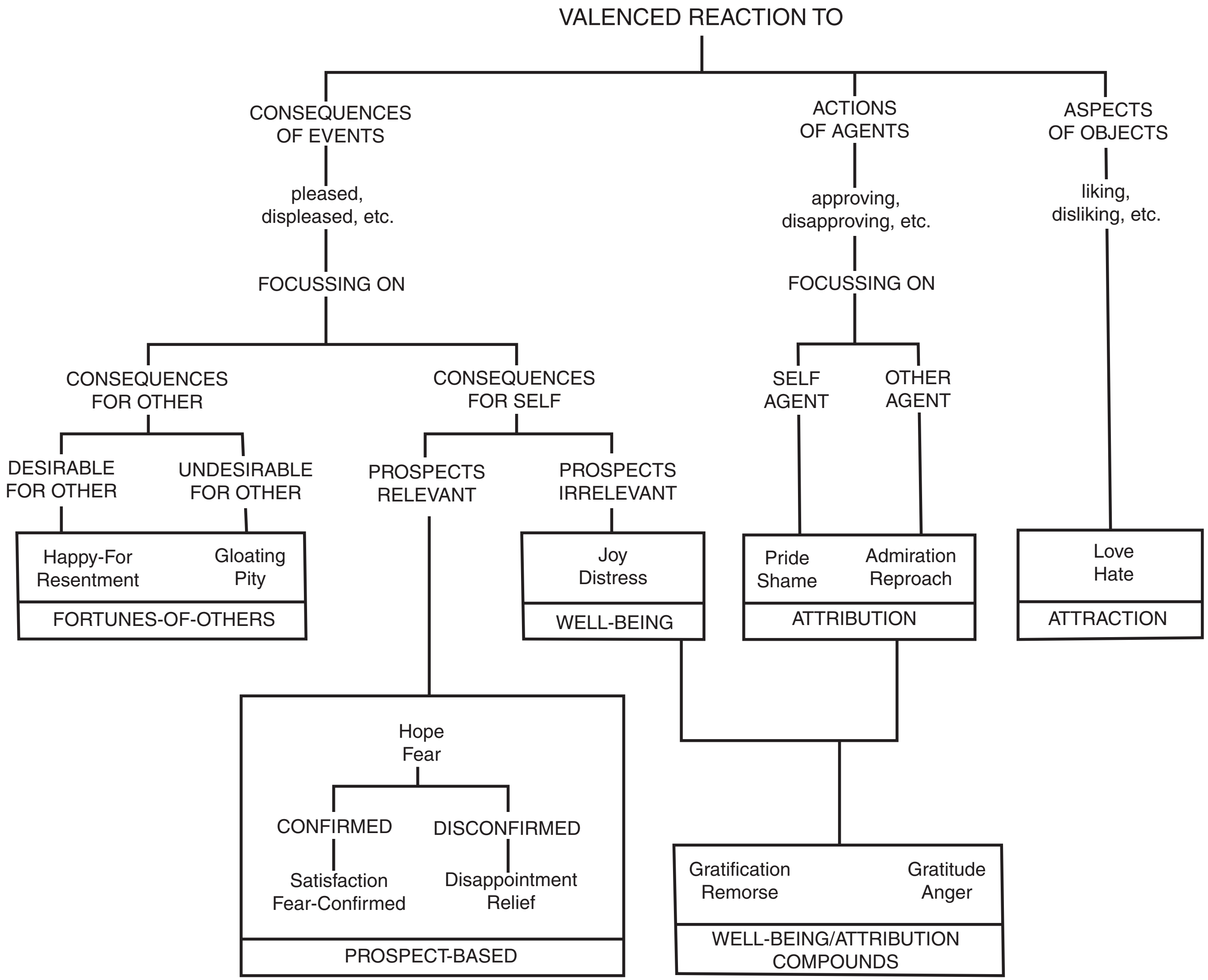



**Figure 2.**
The Ortony *et al.* (2000, p. 30) classification of emotions

Despite the highly fragmented and confuse ideas about emotions regarding, for instance, emotion regulation and its consequences, proposed by the diverse theories in the literature (Leventhal, 1980), OCC has become a standard (the more accepted description of emotions used) in computer science, artificial intelligence and simulation. However, this does not mean either that OCC is necessarily better than other theories of emotions existing in the literature, or that it has successfully solved the difficulties to cope with emotions, but rather that it offers attributes appropriate for many applications. Notably, this theory is very coherent internally and presents a very good structure of emotions, it covers a large range of emotions and it is well suited to formalize and implement in computer.

## 4. SocLab decision-making algorithm and the quantification of emotions

In the original SocLab actors' decision-making algorithm, actors seek to maximize their satisfaction. In the new algorithm being tested in this paper, each actor is equipped with a *moral sensibility* parameter and the maximizing of its own satisfaction is replaced by maximizing its aim that also considers its contribution to the well-being of others. The aim of an actor is defined as a linear combination of its satisfaction (or instrumental goal, what it gets from others to reach its goals) and its influence (what it gives to others), weighted by its moral sensibility parameter, as follows:

$$Aim(a,s) = (1-abs(ms(a))) * Satisfaction(a,s) + ms(a) * Influence(a,s), \qquad (3)$$

where *abs* is the operator absolute value; *Satisfaction(a, s)* is what the actor a receives from others at the configuration s, (see Equation (1)); *Influence(a, s)* is what the actor a gives to others at the configuration s (see Equation (2)); and *ms(a)* is the moral sensibility of the actor a defined in the interval [−1, 1].

The ms parameter of each actor quantifies the relative importance of its instrumental (Satisfaction) and moral (Influence) goals. The higher the value of this parameter, the more the actor considers its contribution to the satisfaction of all others and thus the well working of the organization. Usually, it takes values in [0, 1], as negative values mean that the lower the actor's collaboration (even if it is negative) the higher will be the actor's achievement of its aim, what rarely occurs. Moral sensibility corresponds to the disposition to give importance to moral issues, including the feeling of moral emotions such as shame or pride: the larger the moral sensibility of an actor, the higher the actor's feeling of both positive and negative emotions.

### *4.1 Quantifying emotions in SocLab*

Table I shows the emotions a SocLab actor is likely to feel in a configuration of the organization. The occurrence and intensity of an emotion at a configuration are given in pairs, defined as a potential and two thresholds. If the potential is above the high threshold then the positive emotion occurs, and if it is below the low threshold then the negative emotion occurs. In case the potential is between the thresholds then no emotion appears. The potential of an emotion is defined in proportion as a ratio between what actually happens (e.g. the influence exerted by the actor) and what could happen (e.g. the maximum influence it could exert). Indeed, a social actor "appraises" the situation in the context of the possibilities available for it. The real emotional interpretation of the values of each index depends on the very nature of the organization under consideration and of individual traits of each actor. Globally, considering as an example the Joy/Distress emotion, one could consider that Joy appears above 70 per cent (high threshold) and distress under 50 per cent (low threshold).

These indexes are based on essential properties of configurations, i.e., what is given (Influence) by a to b, and what is received (Satisfaction) by a from b, where a and b may be a particular actor or the whole organization, as shown in Table I. The higher the value of ms of an actor, the higher its concern for collaboration, and so what it purposes to give to others, that is: first, the higher will be the contribution of a to positive emotions of actors who depend on the relation a controls, for instance their joy (joy is based on what the actor receives from itself and others); and second, the higher will also be the intensity of emotions such as Pride of a, which depend on what it gives.

We will use short names for the variables: *Sat(a, s)* for Satisfaction(a, s), *Inf(a, s)* for Influence(a, s), *minSat(a)* (respectively, *maxSat(a)*) for the minimal (respectively maximal) satisfaction a can receive from others. Because of the lack of space, we give the complete definition only for the first emotion, and short summaries of some others (for a complete description of these quantitative measures of emotions see Terán *et al.,* 2014b).

*4.1.1 Well-being emotions: joy/distress*. The OCC model defines joy (respectively distress) as to be pleased (respectively displeased) about the occurrence of a desirable (respectively undesirable) event. In the SocLab model of an organization, the occurrence of such an event corresponds to reaching a regulated configuration that is satisfying (respectively dissatisfying). Joy/Distress of an actor a is given as:

*Potential*: $propSat(a,s) = (Sat(a,s) - minSat(a))/(maxSat(a) - minSat(a))$, which value is in $[0, 1]$.

*Thresholds*: $JoyThresh(a)$ and $DistressThresh(a)$ are the thresholds making actor a liable to these emotions

*Intensity*: $Joy(a,s) = max\{0, propSat(a,s) - JoyThresh(a)\}$

$$Distress(a,s) = max\{0, DistressThresh(a) - propSat(a,s)\}.$$

*4.1.2 Attribution emotions: Pride/Shame and Admiration/Reproach.* An actor could feel prideful (respectively guilty or shameful) when he approves (respectively disapproves) its own praiseworthy (respectively blameworthy) action regarding its effect on itself or on some other actor(s) close to it. But an actor can also feel prideful by a praiseworthy action performed by an actor close to it. This proximity of an actor a towards another actor b can evaluated as its Cognitive Unity *cogUnit(a,b)* ∈ *[1, 1].*

| | | | Influence exerted by | | |
|---|---|---|---|---|---|
| | Self | Other(s) | The whole SOA | SOA and self | SOA and other |
| *Satisfaction received by* | | | | | |
| Self | Pride/shame | Admiration/reproach | Joy/distress | | |
| Other | Pride/shame | Admiration/reproach | If pleased/displeased about desirable event: happy-for/resentment undesirable event: gloating/pity | | |
| SOA | Pride/shame | Admiration/reproach | Joy/distress | Gratification/remorse | Gratitude/anger |

**Table I.** Emotions experienced by an actor in SocLab

Thus, the pride/shame of a when it evaluates what b gives to c will be (it might be the case that either a = b, a = c or b = c):

$$Pride(a,b,c,s) = max\{0,(propInf(b,c,s) - PrideThresh(b,c)) * cogUnit(a,b) * cogUnit(a,c)\},$$

$$Shame(a,b,c,s) = max\{0,(ShameThresh(b,c) - propInf(b,c,s)) * cogUnit(a,b) * cogUnit(a,c)\},$$

where:

$$propInf(b,c,s) = (Inf(b,c,s) - minInf(b,c))/(maxInf(b,c) - minInf(b,c)),$$

$$cogUnit(a,b) = ms(a) * Sol(a,b).$$

provided that *cogUnit(a,b)* > 0 and *cogUnit(a,c)* > 0, otherwise both pride and shame are null.

So, we define pride/shame as the product of a measure of actor a's approval of the action of b (*profInf(a,b,s)*), multiplied by the cognitive units of a with b and with c. This is in accordance with the extension of OCC proposed by Steunebrink *et al.* (2012) (they consider only the case a = c).

The case for Admiration/Reproach is similar but a sees b as another, i.e. *cogUnit(a,b)* is null and so it is not taken into account. Also, a has a positive cognitive unit towards c and it evaluates the influence of actor b on c.

*4.1.3 Well-being/attribution compounds emotions: gratification/remorse and gratitude/anger*. OCC defines gratification (respectively remorse) as being pleased (respectively displeased) about a desirable (respectively undesirable) event or situation that results from oneself action and thus entails the approving (respectively disapproving) of one's own praiseworthy (respectively blameworthy) action. As said above, an event is related with the action of the whole SOA, which results from action of individuals. If the actor feels Joy (respectively Distress) about the situation of the SOA and it considers himself as responsible for it, then it will feel Gratification/Remorse, as follows:

$$Gratification(a,s) = max\{0,(propGSat(s) - GratifThresh(a)) * ms(a) * propInf(a,s)\},$$

$$Remorse(a,s) = max\{0,(RemorseThresh(a) - propGSat(s)) * ms(a) * proInf(a,s)\},$$

where *propGSat*(*s*) is the global proportion of satisfaction the SOA has.

Gratitude (anger) is a similar case to gratification (remorse), but it regards what is given by someone else instead of what is given by oneself (in the right side of the equation we will have *propInf(b, s)* rather than *proInf(a, s)*.

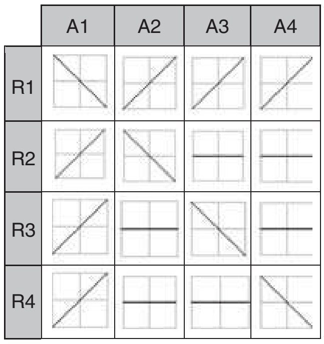
## 5. A case: the Free Rider model

This model includes four actors and four relations, where actor Ai controls relation Ri, for $i = 1, \ldots, 4$. As shown in the left side of Figure 3, A1 depends on the three relations controlled by the other actors with a stake of three on each. Actors A2, A3 and A4 highly depend on the relation controlled by A1 (with stake nines) and every actor depends much more on others than on the relation it controls, in the proportion 1/9. There is no relationship between any pair of actors A2, A3 and A4. The right side of Figure 3 shows the effect functions: for each relation, the functions to the controller actor and the other actor(s) have opposite slopes, that is, the interest of each actor on the relation it controls is contrary to the interest of other actors.

*5.1 Behaviour entailed by the moral sensibility parameter*

The simulation experiments usually converge towards the configurations given in Table II, where each configuration represents a norm of behaviour: either all actors collaborate (configuration C1) or only one of the actors defects (C2, …, C4), rarely two of them defect (C5, …, C7), not often A1 defects (C8), and never three or all of them defect. When ms = 0, the reference case, A1 collaborates in any case and, in most cases, either A2, A3 or A4 defects while benefiting from the cooperation of the two others.

| | | Actors | | | | |
|---|---|---|---|---|---|---|
| | | A1 | A2 | A3 | A4 | Relevance of the relation |
| Relations | R1 | 1.0 | 9.0 | 9.0 | 9.0 | 28 |
| | R2 | 3.0 | 1.0 | 0.0 | 0.0 | 4 |
| | R3 | 3.0 | 0.0 | 1.0 | 0.0 | 4 |
| | R4 | 3.0 | 0.0 | 0.0 | 1.0 | 4 |




**Notes:** In the right side, the effect functions of relations on actors: the satisfaction given to the actor ($y$-axis) depends on the state of the relation ($x$-axis)

**Figure 3.** In the left side: stakes of the actors on the relations (in bold the relation is controlled by the actor) for structure 1/9

| Configurations (state of R1, …, R4) | Satisfaction of (A1, …, A4) | Frequency when ms = 0 for all actors (%) |
|---|---|---|
| C1: (10, 10, 10, 10): all collaborate | (80, 80, 80, 80) | 10 |
| C2: (10, −10, 10, 10): A2 does not collaborate | (20, 100, 80, 80) | 30 |
| C3: (10, 10, −10, 10): A3 does not collaborate | (20, 80, 100, 80) | 30 |
| C4: (10, 10, 10, −10): A4 does not collaborate | (20, 80, 80, 100) | 30 |
| C5: (10, −10, −10, 10): A2 and A3 do not collaborate | (−40, 100, 100, 80) | 0 |
| C6: (10, −10, 10, −10) A2 and A4 do not collaborate | (−40, 100, 80, 100) | 0 |
| C7: (10, 10, −10, −10): A3 and A4 do not collaborate | (−40, 80, 100, 100) | 0 |
| C8: (−10, 10, 10, 10): A1 does not collaborate | (100, −100, −100, −100) | 0 |
| C9: (−10, −10, −10, −10): nobody collaborate | (−80, −80, −80, −80) | 0 |

**Table II.** Typical configurations of the 1/9 free rider game, where a configuration is defined as ($state_{R1}$, …, $state_{R4}$)

The graphs in Figure 4 show the frequency of configurations for the following exploration of parameters: structure of the model, which takes the distribution of stakes 1/9 and 2/8; and moral sensibility (ms) of the actors varying in [0, 0.1, 0.2, …, 1.0]. Each experiment consisted in 200 runs.

We can observe a noteworthy tendency: too much (unconditional) collaboration from one or several actors is not good for the whole organization, as other actors take advantage from this. Let us explain using the graphs:

- case 1: until A3.ms = 0.6, there is no significant change. Then, the higher A3.ms (disposition to collaborate of A3), the higher the number of C1 (all actors collaborate) until A3.ms reaches the value 0.8; when A3.ms is larger than 0.8, the higher the value of A3.ms, the lower the number of C1 since the number of defections of A2 and A4 (C2 + C4) increases considerably.
- case 2: the higher the ms of actors A2 and A3, the higher the number of C1 up to ms = 0.8 because A2 and A3 collaborate more and more while A4 keeps the same behaviour. When ms = 0.9, the number of C1 decreases because A4 collaborates less; 127 experiments converged to the configurations C1 or C7, and four to the configuration C8. For ms = 1 we had difficulties to characterize the simulation output, as the regulated configurations feature intermediate values – for instance [8.5, 3.75, 3, 10] – which are not in the set C1-C8 (this is also the case for about 63

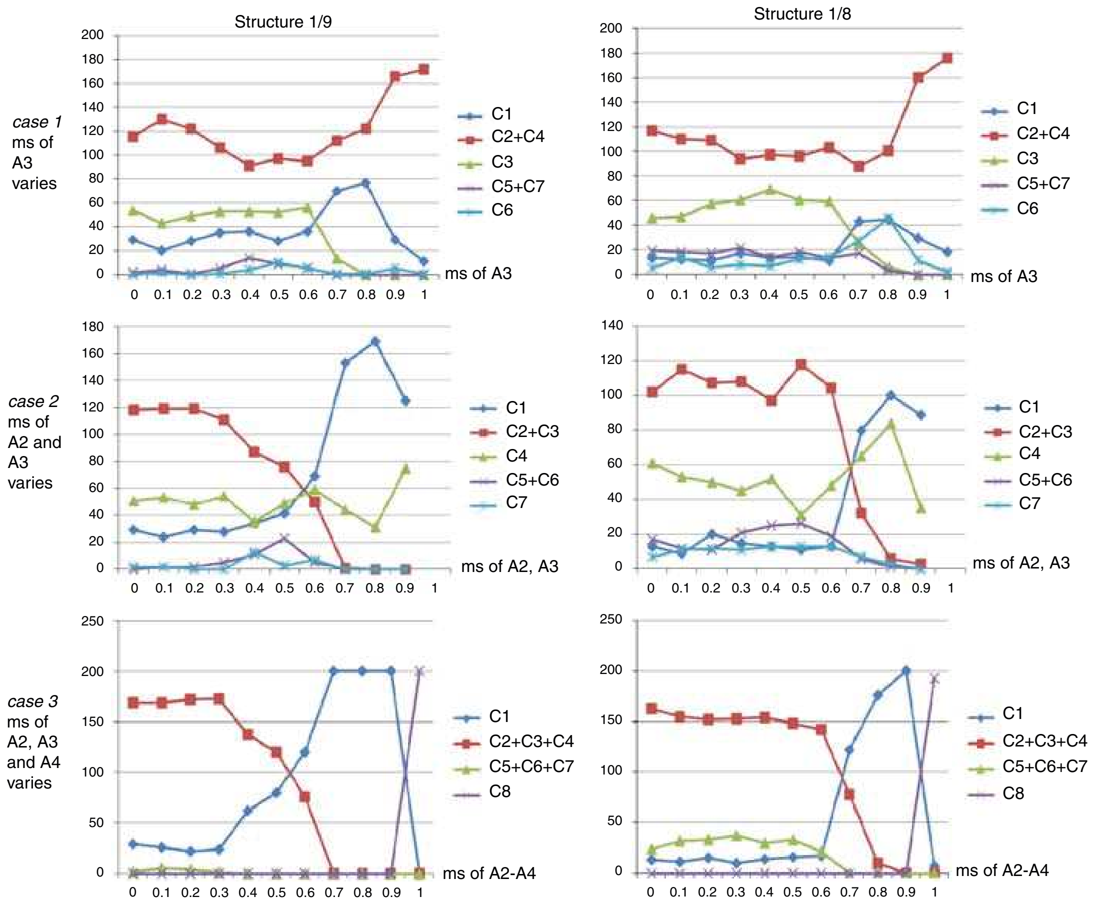



**Figure 4.** Frequency of the configurations C1, …, C8 for a combination of two factors: in columns, the structure of the organization (1/9 or 2/8); in rows, ms varying from 0 to 1 for either A3; A2 and A3; A2, A3 and A4; (ms of A1 is kept to 0)

**Notes:** Results of 200 runs for each combination of factors, configuration C8 and C9 never occur experiments when ms = 0.9). Because of such a difficulty, this set of experiments will not be taken into account in Section 4.2.

- case 3: the higher the disposition to collaborate of actors A2-A4, the higher the number of C1, up to the point where it reaches its maximal value (0.7, …, 0.9 in case of structure 1/9 and 0.9 in case of the structure 2/8); when these actors collaborate unconditionally (ms = 1.0), A1 does not need to collaborate anymore and C8 appears.

These results indicate that the best level of collaboration is between 0.7 and 0.9 rather than 1.0 (systematic collaboration). This is consistent with the well-known Prisoner Dilemma experiences, where the tit-for-tat strategy is better than all other strategies and especially than unconditional collaboration (Axelrod, 1981).

### *5.2 Joy/distress of actors and state of the relations*

This subsection studies the intensity of Joy/Distress, which is selected because it shows the overall state of each actor. We will consider three cases of variation of the moral sensibility parameter: ms of A3 in [0,1]; ms of A2, A3 and A4 in [0,1], and finally ms of A1 in [−1,0]. Only the model with the distribution of stakes 1/9 will be considered.

*5.2.1 Case 1: moral sensibility of A3 takes the values 0, 0.1, 0.2, …, 1.0.* Table III indicates that joy of A1 is maximum when A3.ms is 0.7 or 0.8 because it corresponds to the maximum collaboration of all others; joy of actors A2 and A4 keeps somewhat stable with intensity around 93, while joy of A3 decreases (very) slightly. Joy of A1 decreases when ms of A3 is over 0.8, because A2 and A4 use the high collaboration of A3 to give less. In the lower part of Table III, we see how A3's collaboration (i.e. the state of the relation R3) increases while the one of A2 and A4 decreases. This result confirms the findings described above that actors A2 and A4 benefit from A3's unconditional collaboration.

*5.2.2 Case 3: moral sensibility of A2, A3 and A4 takes the values: 0.1, 0.2, …, 1.0.* Table IV shows how A1 benefits (its joy increases) from the higher collaboration of A2, A3 and A4 as their ms increases. The joy of A2, …, A4 suffers only slight changes. The highest collaboration of A2, …, A4 is reached when ms = 0.7, and stays at that level for higher values. Interestingly, when actors A2 to A4 do collaborate unconditionally (their ms = 1), A1 defects because it no longer needs to cooperate to obtain the others' collaboration. In this case joy of A1 reaches its maximal value (intensity 100), while actors A2, …, A4 are strongly distressed.

*5.2.3 Case 4: moral sensibility of A1 takes the values: 0, −0.1, −0.2, …, −1.0.*. As A1 always cooperates in the reference case (ms = 0 for all actors), the question arises until how low moral sensibility it does so. When ms of A1 decreases from zero towards

| | 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 64 | 62 | 64 | 64 | 63 | 61 | 64 | 71 | 71 | 64 | 63 |
| A2 | 93 | 93 | 93 | 93 | 94 | 94 | 93 | 93 | 93 | 94 | 94.2 |
| A3 | 93 | 92 | 93 | 93 | 93 | 93 | 93 | 91 | 90 | 90 | 90 |
| A4 | 93 | 93 | 93 | 93 | 92 | 93 | 93 | 93 | 93 | 94 | 94.8 |
| R1 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| R2 | 3.6 | 3 | 4.2 | 4 | 3 | 2.7 | 4.6 | 4.8 | 3.7 | 1.2 | 1.7 |
| R3 | 4.4 | 5.3 | 5 | 4.2 | 3.3 | 3.9 | 3.8 | 8.7 | 10 | 10 | 10 |
| R4 | 4.7 | 3 | 3.5 | 4.7 | 5.7 | 4.1 | 4.2 | 3.5 | 3.9 | 1.2 | 0.5 |

**Table III.** Average values of intensity of joy felt by the actors, and of the states of the relations; varied factor: A3.ms negative values, A1 collaborates less and less, reaching the lower point (R1 = −10) from ms = −0.5 (Table V). As A1 collaborates less, A2, A3 and A4 also decrease their level of collaboration. Surprisingly, when A1's ms decreases from −0.1 to −0.2, the collaboration of A2, …, A4 increases considerably, as if they tried to induce A1 to do the same. However, when collaboration of A1 is below −0.3, there is no incentive for other actors to collaborate and they renounce to do so. From 0.5, only the worst configuration C9 occurs.

## 6. Conclusion and further research

This paper has shown the introduction of a moral sensibility parameter in the SocLab actors' decision-making process. This allows the definition of social emotions together with quantitative measures of their potential arousal by actors within organizational settings. The level of its moral sensibility parameter affects the collaboration of an actor, what it gives to others, and consequently the intensity of positive emotions felt by actors who depend on it, including itself. The introduction of the moral sensibility parameter allows actors to orient their selection of a behaviour not only towards their instrumental satisfaction, but also to the search for positive emotions and the prevention of negative ones. It will hopefully permit to overcome some limitations of SocLab, to represent more suitably social organizations and get better results in further research and applications.

Some simulation results about actors' collaboration and emotions in the Free Rider model were presented. A noteworthy tendency is that actors' unconditional collaboration, which occurs when their moral sensibility reaches its highest value, is not so good since it exempts other actors from collaboration (they take advantage from the unconditional collaboration), while values of moral sensibility somewhat below the highest value (between 0.7 and 0.9) still induces collaboration from others.

**Table IV.** Average values of intensity of joy felt by the actors and of the states of the relations; varied factor: ms of A2, A3 and A4

| | 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 64 | 63 | 63 | 64 | 70 | 72 | 79 | 90 | 90 | 90 | 100 |
| A2 | 93 | 93 | 93 | 93 | 93 | 92 | 90 | 90 | 90 | 90 | 0 |
| A3 | 93 | 94 | 93 | 93 | 92 | 92 | 90 | 90 | 90 | 90 | 0 |
| A4 | 93 | 93 | 93 | 93 | 92 | 92 | 90 | 90 | 90 | 90 | 0 |
| R1 | 10 | 10 | 10 | 10 | 10 | 10 | 9.6 | 10 | 10 | 10 | −10 |
| R2 | 3.6 | 4.6 | 4.1 | 4.6 | 4.5 | 5.7 | 7.4 | 10 | 10 | 10 | 10 |
| R3 | 4.4 | 3.1 | 4.1 | 4.5 | 5.2 | 5.8 | 7.4 | 10 | 10 | 10 | 10 |
| R4 | 4.7 | 4.4 | 3.8 | 3.4 | 6.6 | 6.5 | 7.6 | 10 | 10 | 10 | 10 |

**Table V.** Average intensity of joy felt by actors and of the state of the relations depending on A1.ms varying from 0 to −0.7 (for A1.ms from −0.5 to −1 results do not change)

| | 0 | −0.1 | −0.2 | −0.3 | −0.4 | −0.5 | −0.6 | −0.7 |
|---|---|---|---|---|---|---|---|---|
| A1 | 64 | 62 | 83 | 46 | 20.4 | 10 | 10 | 10 |
| A2 | 93 | 94 | 57.4 | 25 | 12.4 | 10 | 10 | 10 |
| A3 | 93 | 93 | 56.5 | 24 | 12.4 | 10 | 10 | 10 |
| A4 | 93 | 93 | 57.8 | 24 | 12.5 | 10 | 10 | 10 |
| R1 | 10 | 10 | 2.4 | −5.3 | −9.2 | −10 | −10 | −10 |
| R2 | 3.6 | 2.8 | 7.4 | 1.3 | −7.5 | −10 | −10 | −10 |
| R3 | 4.4 | 2.6 | 8.8 | 0.1 | −7.5 | −10 | −10 | −10 |
| R4 | 4.7 | 4.7 | 6.7 | −0.2 | −7.8 | −10 | −10 | −10 |

This finding shows how specific simulation experiences that include modelling of emotions might bring in valuable conclusions for public policy.

To be able to quantitatively measure emotions in organizational setting (these understood in a broad sense, including, for instance, institutions and community organizations) would help us in diagnosing the actual state of actors' emotions, defining a desirable/ideal state of emotions of actors in the organizational setting, and inspecting and tracking changes of emotions over time, in order to compare a desirable state with the actual state. All this, in turn, allows managers and policy makers to give appropriate feedback to organizational management via decision making, in order to direct emotions in the organization towards the desirable state, supporting the management of emotions, and helping in detecting the effects of implementing certain forms of emotion regulation. Of course, these applications require a previous validation and theoretical support in relation to emotion regulation and other issues associates with management of emotions, taking into account existing research such as that of Leventhal (1980) and Gross (1998).

Considering emotions in social simulations allows us to introduce emotions as a factor in simulation scenarios analysis. This, in turn, permits to use the SocLab virtual laboratory to learn about the impact of emotions on organizational performance, and to take into account emotions in a large variety of organizational management.

Consequences of all this have a strong potential to impact the whole society, as a result of the improvement of organizational performance and satisfaction of the organization workers. It includes benefits to public policy, since organizational efficiency and effectiveness would be increased – emotion management will accompany and become an ally, to organizational and institutional improvement.

Further research will consider the inclusion of a parameter to represent actor's Group Identification (as defined, among others, by Simon, 1998), which might be more suitable than the moral sensibility parameter to model actors' organizational commitment and motivation. Group identification is understood as an actor's self-concept derived from its awareness of its membership in a group, along with the value and emotional significance of that membership. This notion is also important to determine emotions to actor's cognitive unit with others.

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## Further reading

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